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Endeavour Energy 2024 to 2029 Regulatory Proposal

REVIEW OF ENDEAVOUR ENERGY'S PROPOSED EXPENDITURE FOR CLIMATE-DRIVEN NETWORK RESILIENCE

Report prepared for:

AUSTRALIAN ENERGY REGULATOR

August 2023

Preface

This report has been prepared to assist the Australian Energy Regulator (AER) with its determination of the appropriate revenues to be allowed for the prescribed distribution services of Endeavour Energy from 1st July 2024 to 30th June 2029. The AER's determination is conducted in accordance with its responsibilities under the National Electricity Rules (NER).

This report covers a particular and limited scope as defined by the AER and should not be read as a comprehensive assessment of proposed expenditure that has been conducted making use of all available assessment methods nor all available inputs to the regulatory determination process. This report relies on information provided to EMCa by Endeavour Energy. EMCa disclaims liability for any errors or omissions, for the validity of information provided to EMCa by other parties, for the use of any information in this report by any party other than the AER and for the use of this report for any purpose other than the intended purpose. In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the NER or other legal instruments.

EMCa's opinions in this report include considerations of materiality to the requirements of the AER and opinions stated or inferred in this report should be read in relation to this over-arching purpose.

Except where specifically noted, this report was prepared based on information provided to us prior to 16th June 2023 and any information provided subsequent to this time may not have been taken into account. Some numbers in this report may differ from those in Endeavour Energy's regulatory submission or other documents due to rounding.

Enquiries about this report should be directed to:

Paul Sell
Managing Director
psell@emca.com.au

Prepared by
Gavin Forrest and Paul Sell with input from Bill Heaps

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Energy Market Consulting associates
ABN 75 102 418 020

Sydney Office
L25, 100 Mount Street, North Sydney NSW 2060
PO Box 592, North Sydney NSW 2059
+(61) 2 8923 2599
contact@emca.com.au
www.emca.com.au

Perth Office
Level 1, 2 Mill Street, Perth WA 6000
contact@emca.com.au
www.emca.com.au

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ABBREVIATIONS

Term	Definition
ABC	Aerial Bundled Conductor
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
BAU	Business-as-usual
BCR	Benefit to cost ratio
BoM	Bureau of Meteorology
CBA	Cost Benefit Analysis
CB's	Circuit Breakers
CCT	Covered Conductor Thick
CFI	Case for Investment
CoF	Consequence of failure
CSIRO	Commonwealth Scientific Industrial Research Organisation
DNSPs	Distribution Network Service Providers
DT	Dead-tank
EAC	Equivalent Annualised Cost
ECL	East Coast Low
ESCI	Electricity Sector Climate Information
GCMs	Global Climate Models
LGA	Local Governance Authority
NARCLiM	NSW and Australian Regional Climate Modelling
NEM	National Electricity Market
NER	National Electricity Rules
next RCP	2024-2029 regulatory control period
NPV	Net Present Value
NSP	Network Service Provider
NSW	New South Wales
PoF	Probability of failure
RCMs	Regional Climate Models
RCP	Regulatory Control Period
RCP	Representative Concentration Pathway
RIT-D	Regulatory Investment Test for Distribution
SAIDI	System Average Interruption Duration Index

Term	Definition
SAIFI	System Average Interruption Frequency Index
SAPS	Stand-alone Power Systems
SCADA	Supervisory Control and Data Acquisition
SCW	Severe Convective Winds
STPIS	Service Target Performance Incentive Scheme
the Royal Commission	Royal Commission into National Natural Disaster Arrangements
VCR	Value of Customer Reliability
WALDO	Widespread and Long Duration Outages

1 INTRODUCTION

The AER has asked us to review and provide advice on Endeavour Energy's proposed allowance for climate change-related network resilience capital expenditure for the 2024-29 Regulatory Control Period (next RCP). Our review is based on information that Endeavour Energy provided and on aspects of the National Electricity Rules (NER) relevant to assessment of expenditure allowances.

1.1 Purpose of this report

1. The purpose of this report is to provide the AER with a technical review of aspects of the proposed climate change driven network resilience capex forecast included in the revenue proposal for Endeavour Energy for the next RCP.
2. The assessment contained in this report is intended to assist the AER in its own analysis of the proposed capex allowance as an input to its Draft Determination on Endeavour Energy's revenue requirements for the next RCP.

1.2 Scope of requested work

3. The AER is seeking a technical review of aspects of the capex forecasts proposed to be included in each of the NSW DNSPs[1] distribution revenue allowance for the next RCP, and which was submitted to the AER in January 2023.[2]
4. The scope of this review will include advice to the AER on the investment cases and cost benefit analysis provided in support of the proposed capital expenditure for climate change driven network resilience, where the term network resilience is defined in the AER guidance note.[3]
5. In Figure 1.1 we provide the scope of services requested by the AER for Endeavour Energy.

Figure 1.1: Scope of services[4]

A targeted review

The consultant is required to undertake a targeted review on certain aspects of the NSP's expenditure proposals. These proposals were submitted in January 2023. A targeted review is required on Endeavour Energy's capex and opex forecast for Climate/Network resilience.

Work requirements

A(i) Climate/Network resilience

To assist the AER in its assessment as to whether the NSW DNSP's forecast expenditure for climate/network resilience is prudent and efficient consistent with clause 6.5.7 of the NER, the consultant is required to provide advice to the AER on

1 Ausgrid, Essential Energy and Endeavour Energy

2 As described in the RFQ, AER order for services issued to EMCa and subsequent advice received by email clarifying the scope of works

3 AER guidance note 2022, Network resilience – a note on key issues

4 The scope of expenditure that we have been asked to review was updated following clarification from each DNSP, and is presented in section 3 of this report

the investment cases and cost benefit analysis provided in support of this expenditure. In particular, the consultant must consider:

- *Whether Endeavour Energy has sufficiently demonstrated a causal relationship between the proposed expenditure and the expected increase in extreme weather events; and*
- *Whether the proposed expenditure is required to maintain service levels and is based on the option that likely achieves the greatest net benefit of the feasible options.*

The consultant is required to assess the projects/programs associated with the proposed expenditure of $28 million quoted in Endeavour Energy's proposal.

As part of the assessment, the consultant is also required to:

- *Identify any overlap with other proposed expenditure; and*
- *Flag any proposed expenditure associated with community resilience that would require further review.*

Other requirements

The consultant will be provided with all material Endeavour Energy has provided to the AER in support of their expenditure proposals. The consultant is to have regard to this information and any other information it has available to it in coming to its advice.

Separate face-to-face workshops with Endeavour Energy to deep dive into aspects of their proposals.

The consultant will set out its advice and findings in draft and final reports. This advice must be in sufficient detail to enable the AER to interpret and apply the NER.

The consultant is to provide its reasons in the report and provide any relevant workings to the AER.

The consultant is to engage with Endeavour Energy including any information requests, through the AER.

Source: AER Order for Services issued to EMCa (extract of items related to this report)

6. In discussions with the AER, the focus of the review is on the proposed capex forecast related to climate-change driven network resilience. The AER is not seeking us to form a view on the reasonableness of Endeavour Energy's overall capex forecast or, where proposed, for capex that it has proposed for network resilience that is not presented as being driven by climate change nor for climate change-related expenditure that is not to provide network resilience (such as for 'community resilience'). Where we refer to network resilience or climate resilience in this report, we do so with reference to this definition of our scope.

7. In preparing our findings, we are required to have regard to the AER's role under s.6 of the NER and the AER's forecast assessment guidelines.

1.3 Our review approach

1.3.1 Approach overview

8. In conducting this review, we first reviewed the regulatory proposal documents that Endeavour Energy had submitted to the AER. This includes a range of appendices and

attachments to Endeavour Energy's regulatory proposal and certain Excel models, and which are relevant to our scope.

9. We next collated some information requests. AER combined these with information request topics from its own review and sent these to Endeavour Energy.

10. In conjunction with AER staff, our review team met with Endeavour Energy at its offices on 18 April 2023 including team members via teleconference. Endeavour Energy presented to our team on the scoped topics and we had the opportunity to engage with Endeavour Energy to consolidate our understanding of its proposal.

11. Endeavour Energy provided AER with responses to information requests and, where they added relevant information, these responses are referenced within this review.

12. We have subjected the findings presented in this report to our own peer review and QA processes and we presented summaries of our findings to AER prior to finalising this report.

13. The limited nature of our review does not extend to advising on all options and alternatives that may be reasonably considered by Endeavour Energy, or on all parts of the capex forecast. We have included additional observations in some areas that we trust may assist the AER with its own assessment.

1.3.2 Conformance with NER requirements

14. In undertaking our review, we have been cognisant of the relevant aspects of the NER under which the AER is required to make its determination.

Capex Objectives and Criteria

15. The most relevant aspects of the NER in this regard are the 'capital expenditure criteria' and the 'capital expenditure objectives.' Specifically, the AER must accept the Network Service Provider's (NSP's) capex proposal if it is satisfied that the capex proposal reasonably reflects the capital expenditure criteria, and these in turn reference the capital expenditure objectives.

16. We have taken particular note of the following aspects of the capex criteria and objectives:

- Drawing on the wording of the first and second capex criteria, our findings refer to efficient and prudent expenditure. We interpret this as encompassing the extent to which the need for a project or program has been prudently established and the extent to which the proposed solution can be considered to be an appropriately justified and efficient means for meeting that need;
- The capex criteria require that the forecast '*reasonably reflects'* the expenditure criteria and in the third criterion, we note the wording of a '*realistic expectation'* (emphasis added). In our review we have sought to allow for a margin as to what is considered reasonable and realistic, and we have formulated negative findings where we consider that a particular aspect is outside of those bounds;
- We note the wording '*meet or manage'* in the first capex objective (emphasis added), encompassing the need for the NSP to show that it has properly considered demand management and non-network options;
- We tend towards a strict interpretation of compliance (under the second capex objective), with the onus on the NSP to evidence specific compliance requirements rather than to infer them; and
- We note the word '*maintain'* in capex objectives 3 and 4 and, accordingly, we have sought evidence that the NSP has demonstrated that it has properly assessed the proposed expenditure as being required to reasonably maintain, as opposed to enhancing or diminishing, the aspects referred to in those objectives.

17. The NER's capex criteria and capex objectives are reproduced below.

Figure 1.2: NER capital expenditure criteria

NER capital expenditure criteria

(c) The AER must:

*(1) subject to subparagraph (c)(2), accept the forecast of required capital expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (**the capital expenditure criteria**):*

(i) the efficient costs of achieving the capital expenditure objectives;

(ii) the costs that a prudent operator would require to achieve the capital expenditure objectives; and

(iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.

Source: NER 6.5.7(c) Forecast capital expenditure, v200

Figure 1.3: NER capital expenditure objectives

NER capital expenditure objectives

*(a) A building block proposal must include the total forecast capital expenditure for the relevant regulatory control period which the Distribution Network Service Provider considers is required in order to achieve each of the following (**the capital expenditure objectives**):*

(1) meet or manage the expected demand for standard control services over that period;

(2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;

(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:

(i) the quality, reliability or security of supply of standard control services; or

(ii) the reliability or security of the distribution system through the supply of standard control services,

to the relevant extent:

(iii) maintain the quality, reliability and security of supply of standard control services; and

(iv) maintain the reliability and security of the distribution system through the supply of standard control services; and

(4) maintain the safety of the distribution system through the supply of standard control services.

Source: NER 6.5.7(a) Forecast capital expenditure, v200

1.3.3 Technical review

18. Our assessments comprise a technical review. While we are aware of consumer and stakeholder inputs on aspects of what Endeavour Energy has proposed, our technical assessment framework is based on engineering considerations and economics.

19. We have sought to assess Endeavour Energy's expenditure proposal based on Endeavour Energy's analysis and Endeavour Energy's own assessment of technical requirements and economics and the analysis that it has provided to support its proposal. Our findings are therefore based on this supporting information and, to the extent that Endeavour Energy may subsequently provide additional information or a varied proposal, our assessment may differ from the findings presented in the current report.

20. We have been provided with a range of reports, internal documents, responses to information requests and modelling in support of what Endeavour Energy has proposed and our assessment takes account of this range of information provided. To the extent that we found discrepancies in this information, our default position is to revert to Endeavour Energy's regulatory submission documents as provided on its submission date, as the 'source of record' in respect of what we have assessed.

1.4 About this report

1.4.1 Report structure

21. The following sections of our report are structured as follows:

- In section 2, we present relevant context to our review;
- In section 3, we present what Endeavour Energy has proposed for network resilience, as the basis for our assessment; and
- In section 4, we describe our assessment of Endeavour Energy's proposed capex allowance, and our findings on the prudency and efficiency of that allowance for network resilience.

22. In Appendix A, we provide a comparison of the key assumptions applied for the proposed network resilience expenditure for each of the NSW DNSPs that we have been asked to review.

23. We have taken as read the material and analysis that Endeavour Energy provided, and we have not sought to replicate this in our report except where we consider it to be directly relevant to our findings.

1.4.2 Information sources

24. We have examined relevant documents that Endeavour Energy has published and/or provided to AER in support of the areas of focus and projects that the AER has designated for review. This included further information at virtual meetings and further documents in response to our information requests. These documents are referenced directly where they are relevant to our findings.

25. Except where specifically noted, this report was prepared based on information provided by AER staff prior to 16 June 2023 and any information provided subsequent to this time may not have been taken into account.

26. Unless otherwise stated, documents that we reference in this report are Endeavour Energy documents comprising its regulatory proposal and including the various appendices and annexures to that proposal.

27. We also reference information responses, using the format IR#XX being the reference numbering applied by AER. Noting the wider scope of AER's determination, AER has provided us with IR documents that it considered to be relevant to our review.

1.4.3 Presentation of expenditure amounts

28. Expenditure is presented in this report in $2024 real terms, to be consistent with Endeavour Energy's regulatory proposal unless stated otherwise. In some cases, we have converted to this basis from information provided by the business in other terms.

29. While we have endeavoured to reconcile expenditure amounts presented in this report to source information, in some cases there may be discrepancies in source information provided to us and minor differences due to rounding. Any such discrepancies do not affect our findings.

2 RELEVANT CONTEXT

Our review is conducted in the context that climate change is a global issue with localised impacts. Recent extreme weather events and more broadly trends in a changing climate are being experienced in Australia and felt at a local level by communities. This is occurring against a backdrop of the energy transition.

For electricity networks, this creates a prima facie case for considering the need to build resilience and adaptation to climate change into the provision of their network services.

We have necessarily undertaken our review in accordance with the current planning and regulatory framework that applies to electricity networks. We also provide a summary of the AER guidance provided on climate resilience, and which we have taken into account as a part of our assessment.

In assessing the need and justification for expenditure to mitigate the impacts of climate change, there is a need to make use of available climate change models, and to be able to justifiably deduce from this the potential impacts on the relevant electricity network and the services it provides. It is then necessary to identify potential interventions that may mitigate the impact on network services and to assess to what extent such solutions might be justified, taking account of the timeframe over which such impacts are best addressed.

These models, and the information on the impact of a changing climate on which they rely, continues to mature. This raises the significant possibility of later regret, from overinvestment in the short term predicated on assumptions regarding uncertain long-term impacts that could potentially be addressed more effectively on a more progressive basis. In the face of such uncertainty, there is an option value to undertaking investment progressively and of being able to adapt risk mitigation responses as both the climate impacts on the network and the efficacy of particular intervention solutions, becomes better understood. We have therefore focussed our assessment on the extent to which the NSP has justified its proposed mitigation measures against its assessment of a projected increase in climate related risks to its network assets for expenditure in the next RCP.

Finally, we summarise the implications of the material factors we have identified in the assessment of the proposed capex for the categories of expenditure we have been asked to review.

2.1 Climate change and the regulatory landscape

30. In Australia, there have been a number of recent natural disaster events that had a significant negative impact to our communities and economy, disrupting lives, and threatening our environment – namely bushfires and floods. Weather patterns appear to be increasingly variable.

31. The commonwealth government has established a clear strategic response to climate change which includes the climate impacts, risks and challenges Australia faces, and what actions the Government is taking and is committed to taking. In addition to a set of policy

measures for emissions reduction, there are a range of climate change agencies responsible for adapting to climate change.[5]

32. As noted in Australia's first annual climate statement[6] published in 2022, Australia's national adaptation efforts are underpinned by nationally agreed roles and responsibilities, built on the foundation that risks are dealt with most effectively by empowering those who are best placed to manage them.

2.1.1 Australian climate trends

33. According to both the Bureau of Meteorology (BoM) and the Commonwealth Scientific Industrial Research Organisation (CSIRO) Australia will experience ongoing future climate changes.

34. It is widely acknowledged that weather has an impact on Australia's energy system. As the climate changes, this impact is likely to increase.

35. In response the emerging risks to the National Electricity Market (NEM), the Electricity Sector Climate Information (ESCI) project[7] was launched to improve climate and extreme weather information for the electricity sector. According to the government website,[8] the ESCI project provides information for the electricity sector on likely future climate change scenarios. This is described as being to assist the NEM in being more resilient to climate change and extreme weather events.

36. Specifically, the project has delivered climate and weather information to support electricity sector resilience to climate change and extreme weather events.

2.1.2 Impact to communities of natural disasters and extreme weather events

37. A number of inquiries have looked into responses to natural disaster events, such as the NSW Bushfire Inquiry and the Royal Commission into National Natural Disaster Arrangements (the Royal Commission). As noted by the AER in its guidance note, recommendations from these inquiries focus on actions to address future preparedness for, response to, and recovery from, natural disasters. These inquiries highlighted the importance of "community resilience"– the ability of communities to withstand and recover from the impacts of natural disasters – and the role that different entities need to play to support community resilience.

38. More recently, Resilience NSW and the National Recovery and Resilience Agency have also been set up to assist in supporting communities affected or likely to be affected by natural disasters.

39. In 2022, the electricity distribution businesses in NSW/ACT/TAS/NT commissioned a report titled NSW/ACT/TAS/NT Electricity Distributors, Network Resilience - 2022 Collaborative Paper on Network Resilience. The objective of this report was to understand how DNSPs can best support the communities served in adapting to a changing climate over the next 10 years and the increased community reliance on reliable electrical networks.

40. Community-led approaches to disaster preparedness is critical, adopting a collaborative approach to building resilience. The role of NSPs in supporting network resilience is a collaborative one, shared with government, critical infrastructure operators, individuals and communities who all play a role in supporting community resilience.[9]

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5 https://www.dcceew.gov.au/climate-change/strategies

6 https://www.dcceew.gov.au/sites/default/files/documents/annual-climate-change-statement-2022.pdf

7 The ESCI project is a collaboration between CSIRO, the Bureau of Meteorology and the Australian Energy Market Operator. The Department of Industry, Science, Energy and Resources provided funding for the project.

8 https://www.energy.gov.au/government-priorities/energy-security/electricity-sector-climate-information-esci-project

9 This was emphasised also in the Royal Commission into National Natural Disaster Arrangements, Final Report, 2020, page 230.

2.1.3 Industry in transition

Network investments and the transition to renewables and storage

41. In addition to responding to the need to build greater resilience, the NEM is experiencing a significant transition away from reliance on thermal generation towards renewable generation and storage. This is supported by the Powering Australia Plan including reducing emissions by boosting renewable energy.

42. As a result, the location of these larger renewable energy sources is also shifting to be more geographically distributed and diverse. This will require a substantial investment in transmission infrastructure to enable connection of these new technologies and to facilitate benefits for consumers by way of a lower cost of electricity.

43. At the same time, there has been significant growth in distributed energy resources led by roof-top solar. Customers are now more engaged with their energy system, which is demanding different services in terms of their ability to supply, consume and trade energy. This has implications for investments in energy infrastructure, and digital applications and infrastructure to support changes in how the energy system is used.

44. Adaptation to climate change is a key driver of the energy transition. Not only will this result in investments in new technologies, but there is also likely to be an increasing level of investment required to build resilience of the energy system, to mitigate the negative impacts of changes to the climate on existing infrastructure.

45. We recognise the importance of the energy transition, the need to build resilience and adaptation to climate change and the role of all participants including the network service providers. We have necessarily undertaken our review in accordance with the current planning and regulatory framework. Nevertheless, to the extent that benefits are based on an assessment of a future energy systems, or a projection of a future climate scenario, it is necessary to consider the likelihood of continuing changes to technologies and also changes to the regulatory and planning framework that may affect justification for projects of this type.

Taking account of uncertainty

46. Given the factors described above, and the reality that network investments tend to be both capital-intensive and attract long technical / economic lives, it is particularly necessary to consider option value in assessing deep investments into the electricity network.

47. Considerations of option value and the timeframe over which benefits are adequately able to be modelled, can help to ensure that any network investment is prudent and efficient in accordance with the regulatory objectives. This in turn helps in meeting the objective of ensuring that consumers do not end up paying the risk costs of projects that are developed earlier than required or which become stranded or 'regretted' due to changes in the electricity market, energy system, climate and the technologies deployed there.

48. While we have considered the factors described above, we also caution that these matters are best assessed as part of a regulatory investment test for each investment. No inference from our assessment should be drawn on the need for or benefit of projects generally or their role in facilitating the transition to renewables or adaptation to climate change.

2.2 Relevant AER Guidelines

2.2.1 Network resilience guidance note

49. In April 2022, the AER released its guidance note on the key issues of network resilience.[10]

[10] AER guidance note 2022, Network resilience – a note on key issues. Accessed on 1 June 2023 at https://www.aer.gov.au/system/files/Network%20resilience%20-%20note%20on%20key%20issues.pdf

50. The AER has described the purpose of this guidance note to:[11]

> *'..support broader discussions around network resilience, the AER is publishing a note to assist Network Service Providers (NSPs), consumer groups and advocates understand how resilience-related funding would be treated under the NER.'*

Defining network resilience and community resilience

51. The AER has defined network resilience as:[12]

> *'..a performance characteristic of a network and its supporting systems (e.g. emergency response processes, etc.). It is the network's ability to continue to adequately provide network services and recover those services when subjected to disruptive events.'*

52. The AER has described the relationship between network resilience and community resilience as:[13]

> *'Network resilience has sometimes been used interchangeably with community resilience. These are different but related concepts. A resilient electricity network can assist in building community resilience. But many different entities have a role in supporting communities to withstand and recover from the impacts of natural disasters. Government bodies, individuals themselves and several critical infrastructure operators (beyond electricity networks) have a role to support community resilience.'*

Assessment under the NER

53. In the guidance note, the AER states that it will have regard to the following factors when assessing any funding for network resilience:[14]

- future network needs may not be the same as they are today.
- there is uncertainty as to what the future network needs are.
- there is also uncertainty from other related areas like changes in demand and energy mix as well as technological advances.
- consumer and community preferences will be very important in our consideration.

54. The focus of network resilience is typically to improve service level outcomes that the network provides to consumers. One of the methods available to assess the benefits of proposed expenditure is by measuring the value customers place on reliable electricity. Others may extend to the value of safety and security of the network. In its guidance note, the AER acknowledges the limitations in the application of the Value of Customer Reliability (VCR) for Widespread and Long Duration Outages (WALDO) to accommodate longer unplanned outages with localised impacts.[15] The AER encourages NSPs to demonstrate consumer preferences for proposed resilience-related expenditure using other supporting evidence.

55. The AER nominated a framework for evidence to support resilience expenditure as being prudent and efficient to achieve the expenditure objectives, to demonstrate, within reason, that:[16]

1. there is a causal relationship between the proposed resilience expenditure and the expected increase in the extreme weather events.
2. the proposed expenditure is required to maintain service levels and is based on the option that likely achieves the greatest net benefit of the feasible options considered.

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11 AER guidance note 2022, Network resilience – a note on key issues, page 4

12 AER guidance note 2022, Network resilience – a note on key issues, page 6

13 AER guidance note 2022, Network resilience – a note on key issues, page 7

14 AER guidance note 2022, Network resilience – a note on key issues, page 9

15 AER guidance note 2022, Network resilience – a note on key issues, page 10

16 AER guidance note 2022, Network resilience – a note on key issues, page 11

3. consumers have been fully informed of different resilience expenditure options, including the implications stemming from these options, and that they are supportive of the proposed expenditure.

2.3 Implications for our review

As consultants to the AER, our assessment reflects our scope of review including the AER's definition of network resilience

56. Resilience of an electricity network may extend beyond climate change or weather-related risks to also encompass system strength and under-frequency related risks and can also extend to business continuity and cyber security risks. However, the focus of our review aligns with our terms of reference, which ask to focus on resilience to any increase in risks related to climate change.

57. Furthermore, resilience-related funding is considered to be accommodated by the NER even though it is not explicitly mentioned in the NER.

Climate change is a global issue with localised impacts

58. Our scope of review does not extend to review of the supporting evidence of the science behind climate change or climate change projections. However, to determine its network resilience response and propose network resilience expenditure we expect the NSP to have had regard to evidence of climate change and climate change projections and to have established a causal link between a projected increase in extreme weather events and its proposed expenditure. For this purpose, we have considered the evidence relied upon by the NSP.

59. Factors that determine future climate change include scenarios for future greenhouse gas (GHG) emissions. We have not reviewed, nor have we been requested to review, the methods and tools used to make projections of climate, impacts and risks, and their development by the Intergovernmental Panel on Climate Change (IPCC) of the UN. Global climate models (GCMs) and Earth System Models (ESMs) provide the large-scale picture of the climate and the climate change signal as well as interactions between the components of the global earth system. However, lower resolution models are required to determine resilience and adaptation options at a local level.

60. Regional climate models (RCMs) are climate models in spatially limited domains, and which are developed based on GCMs with enhanced grid resolution that allows for a more realistic regional climate response.

61. To understand the likely impacts of changes to the climate, as a result of increasing levels of greenhouse gases to the atmosphere, NSPs have made reference to the greenhouse gas concentration trajectory adopted by the IPCC referred to as Representative Concentration Pathways (RCP). RCPs represent the range of GHG emissions established by other studies. They include a stringent mitigation scenario (RCP2.6) which is generally considered a low scenario; two intermediate scenarios (RCP4.5 and RCP6.0), and one scenario with very high GHG emissions (RCP8.5).

62. The impacts identified by these models have the potential to profoundly affect the provision of network services and have direct impact to communities that these networks serve at a local level. In the past, the localised impacts of changes in climate have been linked to severe bushfires, storms and floods.

Recognising the uncertainty of available climate models

63. The future is inherently uncertain and these uncertainties are inherent in the available climate models, climate impact modelling and modelling of potential mitigation interventions that NSPs may adopt. Importantly, the available models provide future scenarios and are not a single-path prediction of the future.

64. In our review, we have sought to understand the steps taken by the NSP to take account of the uncertainties of the available models and model outputs and to explore system sensitivities and vulnerabilities, to identify appropriate low-regret resilience options and their timing to be tested against the requirements of the NER.

65. Accordingly, our review considers the extent to which the NSP has demonstrated that the proposed expenditure reflects prudent and efficient investment to prevent or mitigate risks and/or their consequence to the network, associated with adverse outcomes of extreme weather events for consumers.

Evolving nature of climate models and their projections

66. The methods and tools used to make projections of climate, impacts and associated risks are evolving rapidly. We expect that as the models improve, there can be greater confidence in the ability to more accurately understand the nature of impacts and the efficacy of risk mitigation options.

67. We understand that climate models are reasonably accurate at simulating temperature. However, our understanding is that the accuracy is much less for the simulation of rainfall and windstorm and becomes still less accurate the more granular the locality being considered. Recognition of current levels of uncertainty regarding specific impacts at a local level, and the likelihood of their improvement, speaks to the need to carefully consider option value and potential regret in assessments of proposed investments in the short to medium term, where these are predicated on assumed long-term impacts.

We have assessed the classification of network resilience as proposed by the NSP

68. In the guidance note, the AER acknowledges that:[17]

> *'..NSPs play an important role in the provision of essential services to communities in the leadup to, during and after a natural disaster. There are regulatory and statutory requirements that prescribe minimum service levels or standards to ensure continued supply and restoration of services following unplanned outages. It is important to note that the role of NSPs in supporting network resilience is a collaborative one with other responsible entities.'*

69. As noted in the guidance note, we have considered the delineation of roles that different entities may have in supporting network resilience as a part of our assessment of the proposed resilience capex, and its relationship with community resilience expenditure. Our scope of review does not extend to assessment of expenditure proposed for community resilience.

We have had regard to the assessment framework included in the guidance note

70. The guidance note includes reference to four factors to take account of as a part of the assessment of proposed network resilience funding. We have also taken account of the framework proposed by the AER in the guidance note for supporting evidence.

71. Our assessments comprise a technical review. While we are aware of consumer and stakeholder inputs on aspects of what Endeavour Energy has proposed, our technical assessment framework is based on engineering considerations and economics.

[17] AER guidance note 2022, Network resilience – a note on key issues, page 14

3 WHAT ENDEAVOUR ENERGY HAS PROPOSED

Endeavour Energy has proposed climate-related resilience expenditure totalling $28 million (capex) over the next RCP, to mitigate the effects of what it envisages as an increase in network service-related risks due to climate change. Endeavour Energy proposes a program to replace existing 'bare' conductor with covered conductor in some high bushfire-risk areas and a program to raise the height of selected feeders, with additional switching points, in flood-prone areas of its network.

3.1 Overview

72. Endeavour Energy has proposed climate-related resilience expenditure for the next RCP of $28.0 million, all of which is nominated as capex for network resilience. Endeavour Energy has not included expenditure for community resilience stating that it will investigate initiatives to improve community resilience as part of its proposed Innovation Fund.[18] Assessment of the proposed innovation fund is not part of our scope of review.

73. Endeavour Energy has allocated all of the proposed $28.0 million to the repex RIN category. The breakdown of the forecast capex for network resilience into each proposed project is as shown in Table 3.1.

Table 3.1: Total network resilience capex by project for next RCP by year ($m real 2024)

Project expenditure	2024-25	2025-26	2026-27	2027-28	2028-29	Total RCP
AUG-RESILIENCE-PROGRAM-FLOOD	1.2	1.2	1.2	1.2	1.2	6.0
AUG-RESILIENCE-PROGRAM-BUSHFIRE	4.4	4.4	4.4	4.4	4.4	22.0
Total	**5.6**	**5.6**	**5.6**	**5.6**	**5.6**	**28.0**

Source: Endeavour Energy – 10.10 SCS capex listing – January 2023

74. In describing the adjustments that Endeavour Energy made since its Draft Proposal, in response to its engagement process, Endeavour Energy stated that it had made targeted and modest increases[19] to resilience-related expenditure.

3.2 Summary of the basis for Endeavour Energy's proposed expenditure

75. As a new program for the next RCP, there is no separately identified expenditure for 'resilience' in the current RCP. Endeavour Energy recognises in its submission, and in discussions with the AER, that 'resilience' has been historically built into repex and augex, however the standards to which this has been achieved implicitly at that time assumed increasing negative impacts associated with climate change relative to historical levels.

76. Endeavour Energy has claimed adherence to the AER guidance note and we have reviewed these claims as a part of our assessment.

18 Endeavour Energy 0.01 Regulatory Proposal, page 78 and page 202

19 Endeavour Energy 0.01 Regulatory Proposal, page 74

Identified need

77. Endeavour Energy has claimed that the projected change in climate reflects an increasing level of risk of supply interruptions to customers, with increasing impacts from bushfires, heat waves, storms and floods. Endeavour Energy refer to the 2019-20 bushfire season and floods of 2021-2022.[20]

Forecasting of requirements

78. Endeavour Energy commissioned the development of climate impact modelling and economic modelling from Deloitte. From discussions with Endeavour Energy during our onsite meeting, we understand that the economic model resulted in an estimate that Endeavour Energy faced a risk in excess of $6 billion, which Endeavour Energy considered was overstated. Endeavour Energy decided not to rely on the economic model for development of its proposed expenditure for the next RCP:[21]

> *'The climate modelling has been used to develop the "escalation factor" discussed further below, however we have not proposed any projects using the "economic model" developed by Deloitte.'*

79. The projects that Endeavour Energy has included are derived from the application of what it refers to as escalation factors that are based on the climate impact modelling undertaken by Deloitte, to account for the projected change in future climate related risk by Endeavour Energy. Endeavour Energy claims that these factors demonstrate a slowly escalating level of risk.

80. Of the climate change perils considered by Endeavour Energy it has focused on the impacts of bushfire and flood to its network area. In discussion with Endeavour Energy, it cited advice from its consultant Deloitte that it was not wise to place reliance on wind models that result from single climate impact models which had not yet been validated and its level of resolution was not sufficiently granular.

81. The economic modelling undertaken by Endeavour Energy to support the included projects is based within its on-premise integrated information systems, and not in models that could be easily shared with us for review. We requested evidence of the economic modelling steps undertaken by Endeavour Energy, and application of the described escalating factors to assist our review.

Proposed solutions

82. The solutions proposed by Endeavour Energy focus on two programs for a covered conductor replacement program targeting high bushfire risk areas and the raising of select feeders in flood-prone areas of its network.

83. In describing these programs, Endeavour Energy state that:[22]

> *'Collectively [including the proposed Innovation fund of $25 million] these investments are targeted and modest (2.6% of our total capex proposal) and complement existing measures such as continual improvement in our BAU processes for managing emergency response events and unplanned outages, obtaining insurance, and making use of the pass-through framework as required.'*

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20 Endeavour Energy 0.01 Regulatory Proposal, page 52-53

21 Endeavour Energy - IR011 - Capex Climate change resilience response - Public – 20230412, page 1

22 Endeavour Energy 0.01 Regulatory Proposal, page 156

4 REVIEW OF ENDEAVOUR ENERGY'S PROPOSED NETWORK RESILIENCE EXPENDITURE

We consider that Endeavour Energy's proposed capital expenditure does not reasonably satisfy the criteria for definition as 'climate resilience' as defined in AER's guideline as it has not been presented as being based on a causal relationship with increasing extreme weather events. However, in our experience, projects such as Endeavour Energy has proposed typically are justified and it is reasonably likely that they would meet the capex objectives of the NER.

4.1 Overview

84. We have reviewed the information provided by Endeavour Energy to support the proposed network resilience capex included in its climate resilience program, including its investment cases and relevant supporting information as outlined in section 3. Our focus is to assess the extent to which the forecast expenditure is likely to meet the NER criteria and the relevant AER guidance material.

85. In this section, we have considered:

- The investment need – to review the extent that Endeavour Energy has demonstrated a causal relationship between the proposed resilience expenditure and the expected increase in the extreme weather events, including the reasonableness of the assumptions of any risk modelling; and
- The economic modelling – to review (as relevant) the reasonableness of the approach taken by Endeavour Energy to model the benefits of the proposed program, including consideration of alternate options and option value.

86. We have included additional observations to assist the AER with its review, where issues we have identified may extend beyond the scope of our review and require further review by AER staff.

87. As requested by the AER, we have also considered the justification for specific investment cases where included by Endeavour Energy.

4.2 Our assessment

4.2.1 Investment need

Escalation factors have been adopted to represent increasing climate risk

88. Endeavour Energy has adopted escalation factors to apply to its risk modelling to support he projects included in its capex forecast for climate resilience. Endeavour Energy describe the escalation factors as:[23]

> *'Escalation factors are a time-based scalar factor applied to any appropriate risk considered in the development of a CFI. To understand the potential outcome of the climate change-based impact, Endeavour Energy modelled multiple emissions scenarios, under various timeframes (now, 2050 and 2090). The calculation of the*

[23] Endeavour Energy - IR011 – Capex Climate change resilience programs - Public - 20230412, page 3

Escalation Factor is a change in the likelihood (and potential consequence) of a number of climate hazards between now and 2050 or 2090.'

89. In its Bushfire Case for Investment (CFI), Endeavour Energy describes the application of escalation factors as:[24]

'To ensure the electrical network is more resilient to climate change, escalation factors accounting for change in future risk have been applied to Endeavour Energy's existing asset risk framework for assessment of HV distribution overhead conductor linear assets. The application of climate change escalation factors shift forward the optimum timing of intervention for asset investments. The investments which are brought forward improve Endeavour Energy's network resilience to future climate conditions.'

90. We note that Endeavour Energy refer to the 'shifting forward' of the optimal timing of expenditure for projects in response to its application of escalating factors. We therefore reviewed the documentation provided by Endeavour Energy to test the relationship to the escalation factors, and primary driver of the expenditure proposed for the next RCP.

Methodology suggests that the application of its escalation factors may overstate the climate risk assumed by Endeavour Energy

91. Endeavour Energy referred us to the Customer Value Framework (Attachment 10.05) and Asset Risk Methodology (Attachment 10.22) as being applied for the proposed expenditure. We reviewed the value framework provided as Attachment 10.05 and risk model framework provided in Attachment 10.22 and didn't find reference to how the escalation factors have been or are proposed to be applied. The reference to resilience that we did identify was in relation to community resilience benefit from access to renewable capacity, and which does not relate to the proposed expenditure within our scope of review.

92. Endeavour Energy also referred us to Figure 3 in Attachment 10.36 Climate Resilience Methodology which indicates that the consequence of failures will need will be modified based on climate modelling, and which has been reproduced as Figure 4.1.

Figure 4.1: Overview of approaches used for justification of expenditure

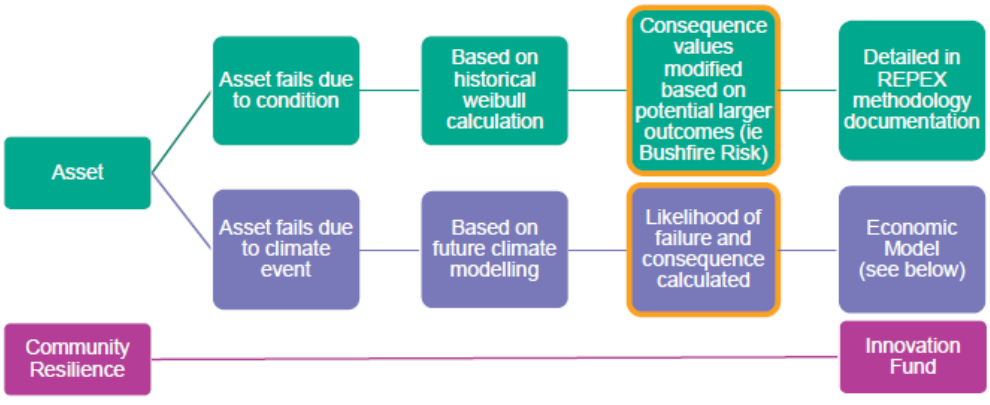


Figure 3 – Justification approaches

Source: Attachment 10.36 Climate Resilience Methodology, Figure 3

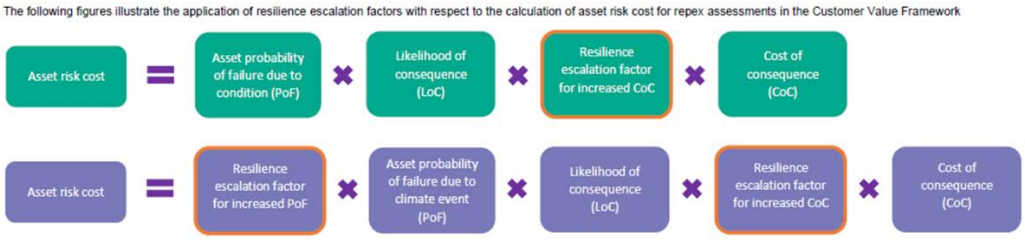
93. Our review of Figure 4.1 and Attachment 10.36, including the emphasis provided by Endeavour Energy, suggests that the escalation factors are applied primarily to the likelihood and consequence values of its risk cost assessment. Endeavour Energy developed an economic model to 'allow for integration of exposure likelihood and asset

[24] Endeavour Energy, Resilience Program Bushfire CFI, page 4

vulnerability'.[25] However, we understand that Endeavour Energy has not applied this economic model in determining its proposed climate resilience expenditure for the next RCP.

94. We asked Endeavour Energy to detail the modelling steps that it had applied in its Cost Benefit Analysis (CBA) that demonstrate the application of escalation factors, including reference to the steps in Figure 4.1. In its response, Endeavour Energy provided the formula reproduced in Figure 4.2. Endeavour Energy describes this formula as illustrating the application of resilience escalation factors with respect to the calculation of asset risk cost for repex assessments in the Customer Value Framework, where applications of resilience escalation factors are denoted with an orange border.

Figure 4.2: Application of resilience models



Source: Endeavour Energy - IR021 - attachment 2b - Public - 20230510

95. As noted above, we could not find reference to this information in Endeavour Energy's value framework. We remain concerned that this may suggest that escalation factors are applied to both the PoF and Consequence values, and which may lead to an overstatement of the identified risk. We therefore sought evidence to confirm that Endeavour Energy had ensured that its application of escalation factors did not result in an overstatement of risk, which in turn would drive the potential for a higher level of expenditure than Endeavour Energy would require.

96. Endeavour Energy describes the inputs relied upon in the Appendix of the respective CFIs. As we were not able to review the individual economic analysis to undertake our own sensitivity analysis, our assessment is necessarily based on Endeavour Energy's descriptions of what it has done, any results that it has reported and our own observations relating to the reasonableness of selected input assumptions (where known).

Determination of reference year for determination of escalating factors disregards option value

97. Endeavour Energy has adopted escalation factors based on its assumed increase in risk to the year 2090, rather than a shorter period, such as 2050. In its regulatory proposal, Endeavour Energy state:[26]

> *'To understand possible future impacts, climate modelling was conducted using multiple climate models under moderate and high emissions scenarios. This was done out to 2090 in order to overcome natural variability over time and to understand the possible hazards our assets will be exposed to over their lifetime. Noting this does not mean that investments will be made now to address all risks over that lifespan.'*

98. We requested that Endeavour Energy provide justification for its use of escalation factors to 2090, rather than a projection at 2050 or 2070 noting that these reference year represent averages over the period.

99. In its response to IR021, Endeavour Energy states that: [27]

[25] Endeavour Energy, Attachment 10.36 Climate Resilience Methodology, page 8

[26] Endeavour Energy 0.01 Regulatory Proposal, page 200

[27] Endeavour Energy - IR021 - Response - Public – 20230510, page 3

'..in the pursuit of ensuring prudent and efficient long-term asset management, we acknowledge the need to understand the possible future environment conditions of our assets. The rate of change between now and 2050 increases at a fairly constant rate, with a much higher acceleration between 2050 and 2090 (depending on the RCP scenario). The assets built are expected to be impacted in this time horizon, and to only consider the 2050 timeframe, would not appropriately represent the incremental hazards the asset will experience in its service life.'

100. Also that:[28]

'…the ESCI data used had 2050 and 2090 datapoints produced. In discussions with Deloitte, they indicated that producing a 2070 datapoint would require extrapolation, and to avoid potentially introducing errors, we only required the 2050 and 2090 datapoints.'

101. We consider that the escalation factor determined for 2090 (once adjusted for an annual increase) is likely to be higher than would be the case if using 2050 or 2070. As noted by Endeavour Energy, there is a higher acceleration of the rate of change of climate risks in its projections between 2050 and 2090, particularly for the higher emissions scenarios, however, there remains material uncertainty the further into the future the projections reach.

102. Given the considerable opportunities available to mitigate risks as their impact becomes clearer, we are not convinced by the suggested need to justify investments made over the five years of the next RCP, based on modelled future scenarios for the period 30 to 70 years hence. To base investment decisions on a scenario this far into the future, would suggest that option value has not been sufficiently taken into account or the possibility that the investment may result in unnecessary 'regret'.

Inconsistencies in description of RCP projection relied upon

103. Endeavour Energy states that it has tested the impact of a moderate and high emission scenario, which it has associated with selection of RCP 4.5 and 8.5. Based on our reading of Endeavour Energy's documentation, the expenditure level corresponding with RCP 8.5 formed the basis of the initial capex forecast that was presented to customers. For the CCT CFI (Attachment 10.38 RESILIENCE-PROGRAM-BUSHFIRE CFI) the difference between the climate projections accounted for approximately $7 million ($31m vs $38.1m). The value of $38.1 million was included in the CFI.

104. From our discussions, Endeavour Energy has proposed its capex forecast based on RCP4.5. From the above, the value of $38.1 million included in its CFI suggests that this is more likely aligned with RCP8.5, and which would have included a higher increase in climate related risk associated with the higher value of capex.

105. Adopting the RCP 8.5 projection assumes more aggressive climate change, and associated increase in climate risk than is present under RCP 4.5 and which is more generally accepted as more probably. Endeavour Energy has not justified selection of its use of this climate projection.

4.2.2 Economic analysis

No evidence provided of CBAs

106. Endeavour Energy did not provide CBA models for its selected investments, given that:[29]

'For geospatial and linear asset management, Endeavour Energy has largely moved to large data based transformation tools for the analysis of probability of failure, probability of consequence and cost of consequence modelling for large asset classes and data sources. These tools identify statistical distributions and locations of assets requiring

[28] Endeavour Energy - IR021 - Response - Public – 20230510, page 3

[29] Endeavour Energy - IR011 - Capex Climate change resilience response - Public – 20230412, page 2

targeted asset management oversight. These risk models reside within the analytic tools themselves, with outcomes translated direct into CFIs.'

107. We requested evidence of adoption of escalation factors, links to climate impact modelling and justification of the parameters included in its analysis to assist our assessment. This was also communicated at our onsite discussion, and which we understood was accepted by those in the meeting. In response to our request, we were offered a further discussion to clarify existing statements and directed to the existing documentation included in the CFI.

108. We consider that evidence of effective cost benefit analysis, including application of reasonable modelling assumptions is a requirement of demonstrating prudent and efficient expenditure under the NER.

Evidence to support selection of its input assumptions not provided

109. We asked Endeavour Energy to provide justification for the input assumptions relied upon for all CBAs, specifically the selection of a 55-year assessment period. In its IR021 response Endeavour Energy stated:[30]

'..we test the bounds of our analysis, by increasing and decreasing variables that have significant impact on the outcome. In this case, we change the capital cost, failure rate (Weibull) and the calculated risk values, the result of which is also shown in the CFI.'

110. Also[31]

'..with the WACC and the level of investment, we found periods up to 55 years still influenced the investment outcome.'

111. We generally consider that much shorter investment periods are prudent given the high degree of uncertainty associated with network investments and the prudent application of option value and minimum regret strategies for a network to progressively undertake the necessary investments over such timeframes. As a minimum, we would expect sensitivity analysis around different assessment periods to be undertaken and presented in the business case.

Application of scenario and sensitivity analysis implies a degree of overlap with the BAU capex program

112. Of the scenarios that Endeavour Energy has assessed, the NPV for the preferred option remains positive across its sensitivity analysis. The analysis was not provided for all options assessed, nor was a comparison made between the two options using the alternative scenarios.

113. For the Bushfire CFI, Endeavour Energy did a further sensitivity check on the application of its escalation factors, as it describes to test the robustness of its evaluation. The conclusion drawn by Endeavour Energy is that assets were effectively brought forward by between 0 and 11 years between each of the scenarios.

114. We observe that scenario 1 was referred to as baseline, and which we understand did not include any escalation factors for climate change and which would therefore be driven by other factors. In this scenario, and on the basis that Endeavour Energy was not addressing an increase in climate risk in its baseline, we would expect that the incremental conductor replacement program, once the BAU repex program was removed, would be zero. However, this was not the case and a program of over 450 interventions is included in the scenario 1 baseline case.

115. In our opinion, this casts a level of doubt over the potential duplication between the proposed resilience program (as being climate driven) and the BAU repex program. We

30 Endeavour Energy - IR021 - Response - Public – 20230510, page 3

31 Endeavour Energy - IR021 - Response - Public – 20230510, page 3

suggest that the AER review the application of its methods, and particularly the justification of the proposed projects and programs against its stated framework.

116. Specifically for the Bushfire CFI, which recommends augmentation with Covered Conductor Thick (CCT), Endeavour Energy states that [32]

> *'Since the same assets are under review and the benefits associated with the proposed asset class CFI are lower than the benefits identified in this CFI, all overlaps of scope have been removed from the "Overhead Conductor Failure Risk Mitigation" CFI'*

117. We suggest that the AER confirms that this is the case as a part of its review of the proposed repex and augex for conductor replacement.

The optimal selection of projects and expenditure to address the identified is not clear

118. Our review of Endeavour Energy's documentation identified reference to $55 million of climate resilience related investments, and which was subsequently reduced to $28 million in its regulatory proposal.

119. We understand the overall portfolio was subject to a top-down constraint,[33] and the climate resilience investments were reduced as noted above. Endeavour Energy describes this process as being a:[34]

> *'..part of our commitment to a value for money proposal, increasing efficiency for customers, whilst reflecting their priorities and preferences.'*

120. We asked Endeavour Energy to describe the optimisation process undertaken to identify a portfolio of $28.0 million which included $17.0 million of deferred expenditure, and specifically the criteria used to optimise the portfolio.

121. Endeavour Energy's response was that:[35]

> *' Top-down (overall portfolio) constraint, middle down composition (category portfolio, e.g system / resilience) and bottom-up build of each of the expenditure category and forecasts for the 2024-29 period apply. The approach differs slightly between investment categories. The overall approach is consistent with the approach described in the Expenditure Forecasting Methodology Statement [link] and further described in section 05 of the Endeavour Energy co-designed Business Narrative [link] supported by customer engagement themes. Refer also attachment 10.04.*
>
> *The approach to top-down constraint includes various factors:*
>
> – *customer and stakeholder engagement*
> – *implications of current period expenditure, PIR and longer-term historical performance*
> – *internal and external benchmarking*
> – *composition of other investment categories and outcomes, internal workshops and outcome priorities, including working within the constraints provided under the Better Resets Handbook approach*
> – *risk appetite and trade-off*
> – *implications for 2030 and beyond*
>
> *The $55m referred to included plans scoped with the RRG which were shared in August 2022.'*

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32 Endeavour Energy, Resilience Program Bushfire CFI, page 17

33 Endeavour Energy - IR021 - Response - Public – 20230510, page 2

34 Endeavour Energy - IR011 - Capex Climate change resilience response - Public – 20230412, page 3

35 Endeavour Energy - IR021 - Response - Public – 20230510, page 2

122. We note that the application of the above factors is likely to place downward pressure on the proposed capex forecast and is evident in the reduction to the proposed climate resilience capex from $55 million to $28 million. However, we did not receive sufficient information to determine how Endeavour Energy has made the optimal selection of projects and expenditure to address the identified risks.

4.2.3 Investment cases

Bushfire CFI

Justification of the proposed augmentation is not compelling

123. Endeavour Energy has included an investment case for HV distribution network resilience and bushfire ignition risk mitigation, which it refers to as the Bushfire CFI. The Bushfire CFI recommends investment in the replacement of high voltage overhead conductor linear assets with CCT across the distribution network during the period of FY23 – FY29 to address the safety, reliability and bushfire risks associated with this equipment failing whilst in service and to improve network resilience.

124. The scope of the Bushfire CFI is to augment 855 overhead conductor linear assets totalling 211km in route length by retirement and replacement with CCT, referred to as option 2.

125. As noted above, Endeavour Energy applies an escalation factor based on its assumptions regarding the climate-related increase in likelihood of a bushfire and this resulted in bringing forward expenditure. As noted above, we have insufficient information in which to determine whether the proposed volume of augmentation is prudent, or otherwise duplicated by other programs.

Options analysis provided is inadequate

126. For the Bushfire CFI, option 1 'like-for-like replacement' considers 611 interventions with a route length of 159kms, whereas option 2 considers 855 interventions with a route length of 212kms. Unsurprisingly the risk reduction for option 2, corresponding with the higher level of interventions all other factors being equal, is higher. It is unclear the degree to which the higher level of interventions has contributed to the higher risk reduction and therefore benefit.

127. As a means for comparison, option 1 has a risk reduction ratio of $0.80 million per intervention for the assumed capital investment, and which would likely be a lower cost option than covered conductor. Option 2 appears to be less 'effective' than option 1 as it has a lower risk reduction ratio of approximately $0.71 million per intervention.

128. When also considering that option 2 has a higher cost per intervention than option 1, this would indicate that all else being equal, option 1 provides higher value per intervention.

Basis for optimal timing and scope are unclear

129. The Bushfire CFI program includes suggested investments across 23-24 and 25-29, corresponding to $30.3 million (FY23) for FY23-24 and $7.8 million (FY23) for FY25-29. The scope for the next RCP (FY25-29) was for 219 interventions across a route length of 43km, and which does not align with other information provided. An additional program is also included for FY30-34 for completeness and falls outside of the next RCP. This additional program has not been considered further.

130. Endeavour Energy states that the optimal timing is selected where the NPV was at its maximum, however we did not see evidence of this assessment. Endeavour Energy also states that the maximum NPV is skewed to the commencement of the program. However, we have not been provided the basis of the selection of the proposed $22 million (FY24) for this program included in the next RCP, other than by reference to the application of Endeavour Energy's optimisation process.

131. Our review of the SCS capex model (Attachment 10.10) indicates that Endeavour Energy is not proposing to incur any expenditure for the Bushfire CFI program prior to the start of the

next RCP, in 2024-25 and which could imply that Endeavour Energy does not view the proposed works as a current risk that warrants mitigation. As this is more likely than not associated with an existing program, we consider the expenditure is likely classified differently for the current RCP. We suggest that AER staff review the historical expenditure for repex and augex programs relating to installation of CCT.

The analysis suggests an underlying need that may be addressed within its BAU program

132. The recommended option in the CFI proposes a total cost of $38.1 million and states that the total NPV of the proposed program is $570 million. The primary assumed benefit is from escalating risk of bushfire incidents arising from conductor failure and which represents 96% of the calculated risk.

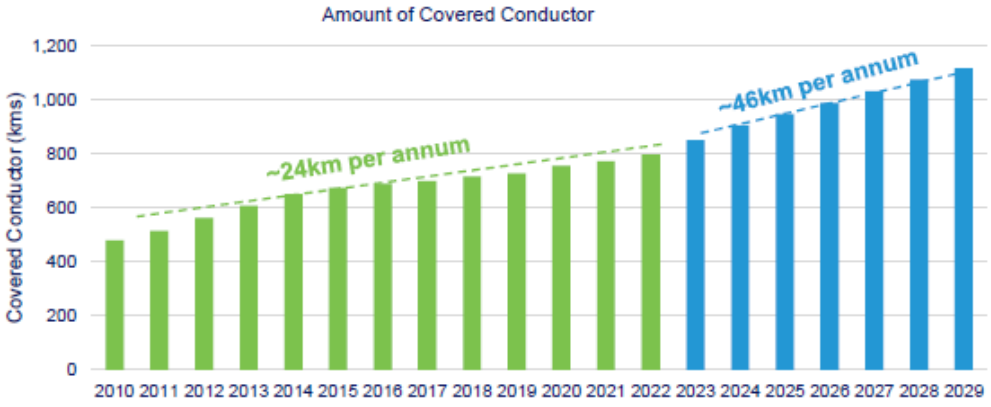
133. However, this is a larger program than has been proposed for the next RCP, and the reduction is only explained by the application of Endeavour Energy's top-down constraint to its portfolio. The associated reduction to benefits of a reduced program has not been provided, nor how this was determined to be reflective of an optimised program.

134. The large benefits suggest this may relate to an underlying risk associated with bushfire incidents, as opposed to an increase in such risk due to climate change and specifically an increase in extreme weather events. We also found conflicting sources of information that relate to the application of its escalation factors, which cast a level of doubt on whether it relates to major events or underlying bushfire risk. For example, Endeavour Energy refers to the increase in likelihood of a bushfire and associated consequence, as measured by increase to assets in the path of a bushfire arising from its modelling. Endeavour Energy also refers to an escalating risk of bushfire incidents arising from failure of the conductor. We cannot determine from the information provided whether this is the same risk expressed differently or intended to reflect an increase in the failure probability of conductors. In the latter case, this would need to be considered as part of the assessment of the proposed repex forecast.

135. From the CFI, Endeavour Energy included 212km of CCT at a unit cost of 180,000/km to arrive at a forecast capex total of $38.1 million.[36] For the revised forecast of $28.0 million, the length of CCT to be installed is approximately 156 km (assuming the same unit rate assumptions), or 31km per year in the next RCP.

136. Based on the information provided in Figure 4.3, this represents an approximate increase of 30% (by volume) to the historical rate of CCT growth as reported by Endeavour Energy, and a reduction to the 46km per annum as shown.[37]

Figure 4.3: Endeavour Energy covered conductor population



Source: Endeavour Energy – AER and EMCa onsite April 2023

[36] This equates to approximately 42km per annum, and which is lower than the value of 46km provided by Endeavour Energy

[37] For simplicity, the driver of the growth in CCT is assumed to be an augex program.

137. We did not see evidence of how the historical program has been taken into account in developing the forecast as a continuing program of work, and specifically whether there is any duplication across other areas of the capex forecast. We consider that the proposed CCT program included within its proposed climate resilience expenditure is more likely than not a continuation of its historical program.

Flood CFI

Proposed expenditure includes reasonable solutions to address reliability risks due to flood events

138. Endeavour Energy has included an investment for flood raising, referred to as its Flood CFI. The Flood CFI recommends investment in the reconstruction of high voltage (HV) and transmission overhead conductor spans identified as being at risk of flood impact, as well as the installation of automated switches across the network during the period of FY23 – FY29.

139. Endeavour Energy describes two focus areas which it describes as minimising customer disruption during flood events as follows:

- Increasing the height of HV overhead conductors above the 1-in-50 year flood level (Distribution) and 1-in-100 year flood level (Transmission).
- Upgrading HV switches to enable isolation to be delayed until flood waters reach critical levels, rather than needing pre-emptive intervention.

140. The scope of the Flood CFI includes:

- improving 26 HV Distribution overhead feeders with spans identified as being at risk from a 1-in-50 year flood event and 7 Transmission overhead feeders with spans identified as being at risk from a 1-in-100 year flood event; and
- the installation of 32 automated HV switches to improve network operability.

141. In our view, these investments will improve network resilience by addressing the reliability risks associated with these assets being affected by flood events, should they occur at these locations.

142. Endeavour Energy claims to have considered and discounted designing distribution mains to be above the 1-in-100 year level due to the much higher level of capex, and restrictions to operational work resulting from non-standard structures. We consider this is reflective of an operator undertaking prudent decision making.

Basis for optimal timing and scope are unclear

143. For the Flood CFI, a single option was presented against the counterfactual of BAU requiring no investment.

144. The process to identify the highest risk sites has not been provided, nor for the determination of the asserted optimal scope of 26 HV feeders, 7 Transmission feeder segments and 32 HV switches.

145. Similarly, the program appears to have been reduced from a total of $7.2 million (FY23) included in the CFI to $6.0 million (FY24) included in the capex forecast, commencing in 2024-25.[38]

Proposed project is more indicative of a response to recent events than impact of increasing climate risk

146. Endeavour Energy has not applied escalation factors to its assessment of this CFI. Rather, it concludes from the climate impact modelling that:[39]

[38] There is an additional $105k included in 2022-23 in the SCS Capex model

[39] Endeavour Energy, Resilience Program Flood CFI page 2

'Based on this advice, future flood events can be expected to remain similar to the past or increase in frequency and severity.'

147. While these measures will improve the resilience of the network to future flood events in these locations, should they occur, we consider that the material presented to us on the Flood CFI is indicative of a response to recent events, rather than a result of assessment of increasing risk of extreme weather or impact of increasing climate risk.

148. The recommended option proposes a cost of $7.2 million and a benefit of $88.2 million compared to the counterfactual case and the overall NPV of $81.0 million. As noted above, this value was subsequently reduced to $6.0 million.

149. On the basis of the claimed $88.2 million NPV for the larger scope, the preferred option is more likely than not to be prudent and, if this result is correct, would appear to be justified without consideration of any worsening risk due to climate change impacts.

Cost estimation

Unit costs appear based on historical costs, and which are within reasonable limits

150. For the two CFIs provided, Endeavour Energy has listed the cost assumptions in an Appendix. We understand that the values provided represent estimates based on past programs and ongoing experience of replacing similar type conductors within Endeavour Energy's network over the past 3 years.

151. Based on proposed volume of work, the unit cost estimates appear to be applied as described.

152. We consider that the estimated costs are within reasonable limits.

4.3 Additional observations

4.3.1 Implications to review of capex allowance, and specifically repex

Review of the application of its optimisation process to account for possible overlap of project and programs is required

153. We have not undertaken a governance and management review of the process applied to develop Endeavour Energy's capex forecast. Based on the issues we have identified, we would suggest that the AER review the application of its methods, and particularly the justification of the proposed projects and programs against its stated framework.

154. In other parts of its proposal, Endeavour Energy is signalling a medium level of expenditure on climate change and extreme weather events as a focus.[40] We found evidence of reference to other initiatives such as the installation of spreaders in high bushfire areas to reduce conductor clashing during high wind conditions. These are not included in the proposed climate resilience expenditure and may be present in other capex categories. We suspect these are examples of initiatives that were removed from the climate resilience program and/or removed during the optimisation process.

155. In describing its approach to developing its bottom-up repex requirements, Endeavour Energy state:[41]

'The introduction of new network options as well as resilience and CER enablement has some overlap with repex. This overlap is considered at both the individual asset level justification for planned repex or at the network-wide level for reactive repex.'

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40 Endeavour Energy, Business Narrative Regulatory Reset 2024-2029, page 40 accessed at https://yoursay.endeavourenergy.com.au/73936/widgets/358165/documents/230639 on 19 June 2023

41 Endeavour Energy 0.01 Regulatory Proposal, page 196

156. We have not reviewed the wider proposal for capex and have not reviewed how Endeavour Energy may have taken these overlaps into account in developing its forecast capex requirements.

157. Accordingly, we suggest that AER staff consider the application of the potential impact of any issues it identified in the governance, management and forecasting methodologies applied more generally to its proposed capex forecast including by reference to projects that may provide a resilience benefit in its repex forecast.

4.4 Our findings and implications

4.4.1 Summary of our findings

Application of Endeavour Energy's methods and assumptions may overstate the risk

158. We found evidence that the methods and assumptions applied by Endeavour Energy in applying escalation factors may result in an overstatement of the climate impact risk that it has assumed.

159. Our assessment was hindered by not having direct access to the models relied upon by Endeavour Energy in developing the proposed capex forecast, and which may address some of the areas of concern.

The proposed CCT program reflects the continuation of a current program rather than to address an increase in extreme events

160. The large benefits associated with this program suggest this may relate to an underlying risk associated with bushfire incidents, as opposed to being reasonably attributed to increasing extreme weather events within the next RCP. However, we found conflicting sources of information that relate to the application of its escalation factors in developing its forecast, which cast a level of doubt on whether it relates to extreme weather events or underlying bushfire risk.

161. The proposed program of $22.0 million is the result of reduction of the initial capex forecast by application of Endeavour Energy's top-down constraint to its portfolio. The associated reduction to benefits of a reduced program has not been provided, nor how the proposed volume was determined to be optimised, prudent and efficient.

162. The historical rate of increasing CCT, and the driver of the large benefits assumed for this project suggest that the proposed CCT program is seeking to mitigate an underlying risk associated with bushfire incidents, and not to maintain service levels in the face of ***increasing*** climate impact.

The proposed flood mitigation expenditure includes a reasonable solution to address a known and current risk of flood events, which will result in local reliability improvement

163. The Flood CFI appears more aligned to a response to recent large scale flood incidents, than a response to changes to climate related risks. It is prudent to conduct post-incident reviews of large-scale incidents and to identify capital and operating expenditure that will provide net benefit to consumers, in accordance with the NER. However, the material provided in support of the Flood CFI does not demonstrate that it is required to maintain service levels in the face of ***increasing*** climate impact.

4.4.2 Summary of adherence to AER resilience guidance note

164. We have reviewed the relevant factors of the framework for evidence to support resilience expenditure as being prudent and efficient to achieve the expenditure objectives.

Endeavour Energy has not establishment an adequate causal relationship between the proposed resilience expenditure and the expected increase in the extreme weather events

165. We find that Endeavour Energy has presented materials that reflect the impact to consumers of recent weather events, and that this impact has been exacerbated by extended outages of electricity supply.

166. The two CFIs included by Endeavour Energy are reasonably aligned with the recent experience of Endeavour Energy's customers and the potential for similar extreme weather events in the future. Further, the expenditure addresses underlying network and safety risks that, if they can be mitigated at a justified cost, will likely provide a benefit to consumers. However, the material that Endeavour Energy has provided does not sufficiently justify the proposed expenditure that may be reasonably attributed to ***increases*** in extreme weather events within the next regulatory period.

Endeavour Energy has not effectively demonstrated that the proposed expenditure is required to maintain service levels and is based on the option that likely achieves the greatest net benefit of the feasible options considered

167. Endeavour Energy's approach has identified a potential increase in risk of extreme weather events for bushfire and flood risk, and which it has related to recent events experienced by its consumers. However, we consider that the assessment of the risk does not support the proposed expenditure and does not sufficiently demonstrate that it is required to maintain service levels in the face of ***increasing*** climate impact.

4.4.3 Implications of our findings for proposed expenditure

168. We consider that the proposed expenditure does not reasonably satisfy the criteria for definition as 'climate resilience' as defined in AER's guideline as it has not been presented as being based on a causal relationship with increasing extreme weather events. However, in our experience, projects of this nature typically are justified and it is reasonably likely that they would meet the capex objectives of the NER.

APPENDIX A – COMPARISON OF ASSUMPTIONS APPLIED BY NSW DNSP

169. In this appendix, we provide a comparison of the assumptions applied for each of the NSW DNSPs in the development of its climate-driven network resilience capex proposed for the next RCP. This covers:

- Comparison of proposed capex;
- Climate impact modelling assumptions;
- Projected asset failures; and
- Projected total financial cost.

A.1 Comparison of proposed capex

A.1.1 Proposed capex

170. In Table A.1 we provide a comparative analysis of the proposed capex included for network resilience.

Table A.1: Comparison of proposed capex for network resilience

Metric	Ausgrid[42]	Essential Energy	Endeavour Energy
Proposed capex ($m, real 24)	193.7	127	28
Average number of customers	1,837,757	969,252	1,225,827
Average route line length (km)	40,588	180,640	30,976
Capex / customer ($)	105	131	23
Capex / route km ($)	4,772	703	904

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

171. The customer numbers and route length are based on reported information in the Reset RIN for each NSW DNSP, using the average of the forecast over the next RCP.

172. From Table A.1 we observe that:

- Essential Energy has the highest proposed capex per customer of the NSW DNSPs, with approximately half the customers of Ausgrid, and lower than Endeavour Energy.
- Ausgrid has the highest proposed capex per route km of network of the NSW DNSPs. This is likely to be higher if the route length was limited to overhead network only.

173. These metrics are not intended to be used exclusively or form the basis of our assessment. For example, the metrics do not include other factors that may further differentiate the operating environment for each NSW DNSP, and which include urban versus rural networks, overhead versus underground networks etc.

[42] The updated information provided by Ausgrid on 17 July includes a lower proposed capex, however does not materially change the results of the comparison between NSW DNSPs

174. Further, these metrics should not be relied upon to review a category of the proposed capex without considering the remainder of the capex forecast, and interaction with the opex forecast to meet service standards. We have not undertaken, nor were we asked to undertake or to review, comparative benchmarking analysis of DNSPs whose network prices are subject to the AER's regulation.

A.1.2 Source of proposed capex

175. In Table A.2, we provide a summary of the primary sources of proposed capex included by each of the NSW DNSPs for the next RCP. Our focus is on comparing the primary network solutions proposed to be applied to address local impacts of extreme weather events.

Table A.2: Summary of primary sources of network resilience capex by NSW DNSP

Sources of expenditure	Ausgrid[43]	Essential Energy	Endeavour Energy [44]
Proactive pole replacement		☑	
Undergrounding	☑	☑	
Covered conductor (or similar)	☑		☑
Switching / sectionalising	☑		
Conductor raising			☑

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

176. From Table A.2, we observe that:

- Two DNSPs have included solutions of CCT and undergrounding, being the dominant sources of expenditure.
- The remaining solutions have been adopted by a single DNSP only.

[43] The updated information provided by Ausgrid on 17 July introduces additional sources of capex associated with its 'Whole of Network solutions' proposal

[44] IR011, Endeavour Energy state that where projects have not been cost justified (for example, the proactive replacement of in service timber poles with alternates), these have not been part of its Proposal

Table A.3: Summary of perils responded to by NSW DNSP

Included drivers of network expenditure	Ausgrid[45]	Essential Energy	Endeavour Energy
Extreme heat	☑		
Bushfire	☑	☑	☑
Windstorm	☑	☑	
Flood		☑	☑
Coastal inundation			

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

177. From Table A.3, we observe that:

- All three DNSPs have included the increased risk from bushfire as a driver of network resilience capex.
- Two DNSPs have included the increased risk from windstorm and flood as drivers of network resilience capex.
- One DNSP has included the increased risk from extreme heat as a driver of network resilience capex.

178. We have assessed each of these drivers in our reports for each DNSP.

179. Despite having considered multiple potential perils, it is notable that:

- Almost all of Ausgrid's proposed network resilience capex is proposed as mitigation for assumed increase in windstorm impacts.
- Essential Energy's and Endeavour Energy's dominant proposed network resilience capex is against assumed increase in bushfire impacts. Of these, Essential Energy's bushfire related programs target exogeneous fire starts and Endeavour Energy's bushfire related program targets fire starts from the network.

A.2 Climate impact modelling assumptions

180. In Table A.4, we provide a summary of the assumptions applied for each of the NSW DNSPs in development of its climate impact modelling.

[45] The updated information provided by Ausgrid on 17 July introduces responses to all climate perils, when considering the additional sources of expenditure (capex and opex) associated with its 'Whole of Network solutions' proposal

Table A.4: Summary of model input assumptions by NSW DNSP

Input assumption	Ausgrid	Essential Energy	Endeavour Energy
Climate impact 'peril' addressed by capex	Bushfire, windstorm, flood, heatwave	Bushfire, windstorm, flood	Bushfire, flood
Climate impact modelling undertaken	Yes	Yes	Yes
Climate impact model relied upon for capex forecast	Yes, fully	Yes, partly	Yes, partly
Dominant climate impact 'peril' driving capex	Windstorm	Bushfire	Bushfire
Climate projection assumed for determination of its proposed capex	Weighted approach: 15% RCP 2.6, 70% RCP 4.5, and 15% RCP 8.5	100% RCP 4.5	100% RCP 4.5
Projection scenarios developed	2050, 2070 ,2090	2050, 2070, 2090	2050, 2090

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

181. From Table A.4, we observe that:

- All three DNSPs have developed and relied upon in some form climate impact modelling to develop the proposed capex forecast.
- However, the climate impact (or perils) modelled differ considerably across the DNSPs, with Ausgrid including a higher incidence of climate impacts.
- Similarly the climate projections assumed and projected scenarios differ across NSW DNSPs, and may impact the rate of increase in climate risk, amongst other things.
- The climate impact of increasing bushfire risk was the dominate climate impact driving capex for two of the three NSW DNSPs.

182. While it is to be expected that climate change will impact different networks differently, we consider that the extent of the differences between the DNSPs' in their projected impacts also reflects the significant challenges and uncertainties that are inherent in the modelling that they have relied on.

A.3 Climate impact to 2050 for RCP4.5

183. In Table A.5, we provide a summary of the percentage increase in climate impact for RCP4.5 to the year 2050 for each NSW DNSP. This is based on our assessment of the material provided. Where items are left blank, we were not able to identify information on a common basis to include in this table.

Table A.5: Climate impact: Assumed percentage increase to 2050 for RCP4.5 by NSW DNSP

Input assumption	Definition	Ausgrid	Essential Energy	Endeavour Energy
Consecutive hot days – total	The total number of heatwave days (3 or more days > 35 deg C)	103%	-	89%
Consecutive hot days - maximum	The longest run of consecutive hot days > 35 deg C	22%	21%	-
Windspeed maximum	Speed of sustained wind gusts	3%	2.1%	-
Windstorm	Impact of intense East coast low events	23%	10%	-
Very heavy precipitation days	Days with more than 30mm of precipitation linked to flooding	20%	-	-
Flooding	Flood level > 0.6m	-	1.9%	-
Flooding	1 in 20 year extreme rain event	-	-	3%
Very high fire danger days	Days with a forest fire danger index FFDI >25	0%	-	39%
Extreme (and above) fire danger days	Days with a forest fire danger index FFDI > 50	13%	-	-
Bushfire footprint	The number of assets within a bushfire footprint	-	10%	-

Source: EMCa analysis of information provided by Ausgrid, Essential Energy and Endeavour Energy

A.3.1 General observations

Extreme heat

184. In general, all DNSPs are forecasting an increase in heatwaves.

Windspeed & windstorms

185. In general, all DNSPs consider that there is very little change seen to maximum sustained wind speed, however, are projecting a higher number of windy days.

186. The climate modelling includes a projection of the number of East Coast Low Pressure System (ECL) events. DNSPs describe ECLs as often leading to damaging winds and thus increased asset failures from direct impacts and vegetation fall/blow ins.

187. The data relied upon by each DNSP differs materially as shown in Table A.5. For example:

- Essential Energy has made corrections to the climate modelling for windspeed, noting that it peaks in 2050 before reducing in 2070. Accordingly, Essential Energy has adopted a straight-line projection of impacts from 2020 to 2070, to account for overstatement in 2050.
- Endeavour Energy has stated that the advice from climate scientists is that the confidence in current climate modelling is not high. Accordingly, Endeavour Energy has not included or relied on wind exposure modelling into its climate projections until such time that better data becomes available.[46]

[46] Endeavour Energy 10.34 Climate resilience methodology

Flooding

188. In general, all DNSPs are forecasting a minor increase in the frequency of flooding. However, Essential Energy includes an increase in flood severity within its projection.

Bushfire

189. In general, all DNSPs are forecasting a minor increase in the frequency of bushfire exposure.

A.4 Asset failures

190. The asset failures modelled for each of the NSW DNSPs are provided for RCP 4.5, not considering any incremental costs for other RCP scenarios. Values are expressed as the average number of asset failures (units) per year.

Ausgrid

Table A.6: Projected asset failures by year – Ausgrid (units)

Input assumption	2020	2050	2070	2090
Bushfire	303	317	364	410
Windstorm	1623	2074	2698	3323
Flood	22	23	23	22
Total	1948	2414	3085	3755
Increase relative to 2020	-	24%	58%	93%

Source: EMCa analysis of information provided by Ausgrid

191. In addition to the above, Ausgrid nominate feeder replaced expressed in km pa.

192. The dominant driver of asset failure for Ausgrid is windstorms which accounts for 80% of all modelled asset failures.

193. The rate of change is highest for Ausgrid was windstorm followed by bushfires.

Essential Energy

Table A.7: Projected asset failures by year – Essential Energy (units)

Input assumption	2020	2050	2070	2090
Bushfire	491	545	610	685
Windstorm	318	550	400	426
Flood	248	255	257	259
Total	1057	1350	1267	1370
Increase relative to 2020	-	28%	20%	30%

Source: EMCa analysis of information provided by Essential Energy

194. The dominant driver of asset failure for is bushfire, however this accounts for approx. 46% in the baseline asset failures.

195. The rate of change is highest for Essential Energy is bushfires followed by windstorms.

Endeavour Energy

196. Projected asset failure information was not provided. Instead, the increase in exposure risk was used as an escalation factor.

197. Climate modelling commissioned by Endeavour Energy from Deloitte has indicated that across a range of future emission scenarios, localised risks across the network are changing because of climate change. The climate modelling has indicated that risks such as bushfire risk are forecast to increase due to a higher likelihood of bushfire favourable weather in future climatic conditions.

198. The escalation factors make use of risk levels in 2090 for each geographical area.

A.5 Total financial cost

199. The total financial costs modelled for each of the NSW DNSPs are provided for RCP 4.5, not considering any incremental costs for other RCP scenarios. Values are expressed in total financial cost $m per annum, including direct and indirect cost components (such as Value of Unserved energy).

Ausgrid

Table A.8: Projected total financial cost by year – Ausgrid ($m per annum)

Input assumption	2020	2050	2070	2090
Bushfire	22	23	27	31
Windstorm	244	306	560	814
Flood	2	3	3	3
Total	268	332	590	848
Increase relative to 2020	-	24%	120%	216%

Source: EMCa analysis of information provided by Ausgrid

200. A similar relationship exists for financial costs as identified for asset failures.

201. Increases in financial cost for Ausgrid are far in excess of other DNSPs, largely due to its assumed cost (and rate of increase in cost) of windstorms.

Essential Energy

Table A.9: Projected total financial cost by year – Essential Energy ($m per annum)

Input assumption	2020	2050	2070	2090
Bushfire	11.2	12.6	14.1	15.9
Windstorm	3.4	5.8	4.3	4.6
Flood	10.2	10.5	10.6	10.7
Total	24.8	28.9	29	31.2
Increase relative to 2020		17%	17%	26%

Source: EMCa analysis of information provided by Essential Energy

202. A similar relationship exists for financial costs as identified for asset failures.

Endeavour Energy

203. Projected financial costs information was not provided.